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A QUANTITATIVE STUDY OF D. BREVICOMIS BROODS, THEIR MORTALITY, THE EFFECT OF PREDATORS AND EMERGENCE PERIODS FOR D. BREVICOMIS AND T. NIGRIVENTRIS.

Northfork, Calif.

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A Quantitative Study of D. brevicomis Broods. Their Mortality, The Effect of Predators and Emergence Periods for D. brevicomis and T.nigriventris.

Variability in D.b. Broods in the Same Tree.

A considerable amount of time has been spent, principally at the Ashland and Northfork Stations, in the accumulation of D. brevicomis brood count and emergence records. Many square feet of bark has been shaved up and an accurate count of the D. brevicomis contained, in various stages, as well as predators and secondary insects, has been kept. On the basis of these brood counts, together with attack and emergence records we have figured the average brood per sq. ft., the percent of mortality at different stages, the "normal" attack and emergence, the relation of the number of beetles emerging to the stage of an infestation, declining or increasing, and other related statistics. The men connected with this work have realized that the basis for these figures was not sound because of the high degree of variability in all of the brood counts, not only in different trees under the same conditions but also in the different parts of the same tree.

The attack per sq. foot has usually been found to be fairly constant averaging around 17.6 beetles per sq. foot of bark. However, on the California Forest it was found from a count of 15 sq. ft. of bark from three trees, that the attack, which occurred during the heavy epidemic condition of 1922, was over 40 beetles to the sq. ft., while the "normal" attack is 17.6. Patterson, from brood counts made over a period of years in the Rogue River Area found that there was a definite relation between the emergence from an infested tree and the stage of the infestation and that with a declining infestation the emergence per sq. ft. was smaller. Keen, from brood counts made on the So.Ore.-N.Calif. Control Project, got results just as definite but to the effect that in a declining infestation the emergence was larger. These examples may be exceptional but they show that there must be great differences in any of the brood counts and unless carefully made and carefully used will lead to unreliable conclusions.

Recently, while working up records from live trees infested with the 1922, over-wintering D.brevicomis brood, graphs were made which show clearly the fact that bark counts made from sections selected at random are too variable to be of value unless the number is large enough to make a good average.

The tree F 1602 was felled in the early spring of 1923. At that time the tree was infested with a heavy brood of D. brevicomis medium to large larvae. Sections of bark were taken at five foot intervals for the

full infested length of the tree of 105 feet. From each of these sections one sq. ft. was saved for rearing and another sq. ft. was shaved up and brood counts made by A. Wagner. When the brood had emerged from the reared bark the emergence and ventilation holes were counted. From these records it was possible to figure the size of the brood at the medium larval stage, the total emergence and the brood mortality at five foot intervals for the whole tree. The results are shown on Plate I. It is evident from this diagram showing a brood varying from 3 to over 600 to the sq. ft. and an emergence varying from 0 to 256, that a section of bark selected at random from this tree might give a very poor index of the brood in the tree as a whole.

The other tree used, F 1640, was studied more carefully. It was a large tree, 56" in diameter and 130' in height with an infested length of 70'. This tree was felled in February 1923, and practically all of the infested bark was collected for a cage experiment to find the relation between the number of predators and the brood mortality. This bark was also grouped into five foot sections and the height of each section from the base was marked. One sq. ft. from each section was carefully shaved up and counts made of D. brevicomis brood and the predators and secondary insects.

The remainder of the bark was caged and the emerging insects were collected daily or at intervals of two or three days. The insects collected were preserved in alcohol and labeled according to the date of collection.

The bark from which the beetles emerged was worked over and D. brevicomis counts made. As the emergence from an average of 9 sq. ft. of bark was counted for each five foot section, these figures give a good basis for platting the emergence at different heights on the tree. The brood counts, of one sq. ft. of bark for every five feet section, were compared with this emergence and the mortality figured. The results are shown graphically on Plate II. where the larval brood, emergence and mortality has been graphed in relation to height on the tree. As in Plate I the outstanding point is the great variability of the broods at different heights showing how unreliable conclusions might be if drawn from brood counts taken at only one point on the tree, as for instance at the base. In both of the trees the brood was smaller on the middle part of the trunk than it was near the base and near the top of the infested area.

While it requires a large amount of time to work up brood counts according to the method used for this study, it is believed that the results are of enough value to be worth the effort. A few carefully selected trees

worked up in this way would be of more value than records from hundreds of sq. ft. of bark selected at random. To make similar studies more complete the number of entrance holes should also be counted.

Relation of Predators to D.b. brood Mortality

Tree F 1640 was used for this study also. The method used was to compare the number of predators in a square foot of bark at a certain height on the tree with the brood mortality at the same point. The clerid, T. nigriventris and the astomid, Temnochila virescens chloredia are the only predators of importance found in the bark, and so are used in this study. The number of predators was determined by shaving up a square foot of bark from each five foot section of the tree. The brood mortality used is the same as given in Plate II.

The results are given on Plate III. This shows a very nice correlation between the number of predators and the brood mortality from the medium larval to the adult stage. It is evident, however, that the basis is insufficient and merely serves as an indication. It is planned to do more work along this line.

Emergence Periods for D.b. and T. nigriventris

A total of 175 square feet of bark from tree F 1640 was used to determine the emergence periods for D. brevicomis and the clerid, T. nigriventris. This bark was placed in a 5⅓' x 5½' x 6', muslin cage about March 1st, 1923. The emergence was collected daily or at least every two or three days. The insects were preserved in alcohol in glass vials labeled with the date collected. During the following winter this material was worked over and the average daily emergence by five day periods was completed for both the D.b. and the clerid. The results are shown graphically on Plate IV. The clerid graph is greatly exaggerated as it would have been hard to trace if put on the same scale as the D.b. When the D.b. collected was compared with the emergence holes for this bark it was found that only 8,702 beetles were collected out of 14,640 that must have emerged, according to the number of exit holes. This loss is due to some leakage from the cage and the feeding of insect predators and lizards which were found in the cage. The temperature factor was introduced by plotting the mean maximum temperature by five day periods.

It is noticeable that the D. b. emergence is divided into a short period and a long period. This division into two periods is probably due to two factors, the temperature and the stage of the brood in the bark. When caged the bark contained some overwintering adults and the warm weather during the latter half of March brought most of these out. During most of April the temperature was low and very little emergence occurred so that when the temperature jumped up during the first part of May the emergence reached its peak. It is probable that there would have been a slight dropping off of emergence after the peak of March 30, regardless

No. of Predators (*T. nigriventris* and *Temnochila virescens chlorodia*) Per Sq. Ft. and Per 100 D.b. at Larval Stage.

Using the number of predators per 100 D.b. as a basis the relation to mortality is not as close as when the number of predators per sq. ft. is used. It does indicate that there is a relation, however, especially in the last half of the curve. Evidently the predators are most effective where the D.b. broods are heavy.

of the temperature since there is naturally a decrease in emergence between the peak of the overwintering adult emergence and the beginning of the overwintering larval emergence. It is certain, however, that the cold weather during April accentuated this condition.

PLATE I

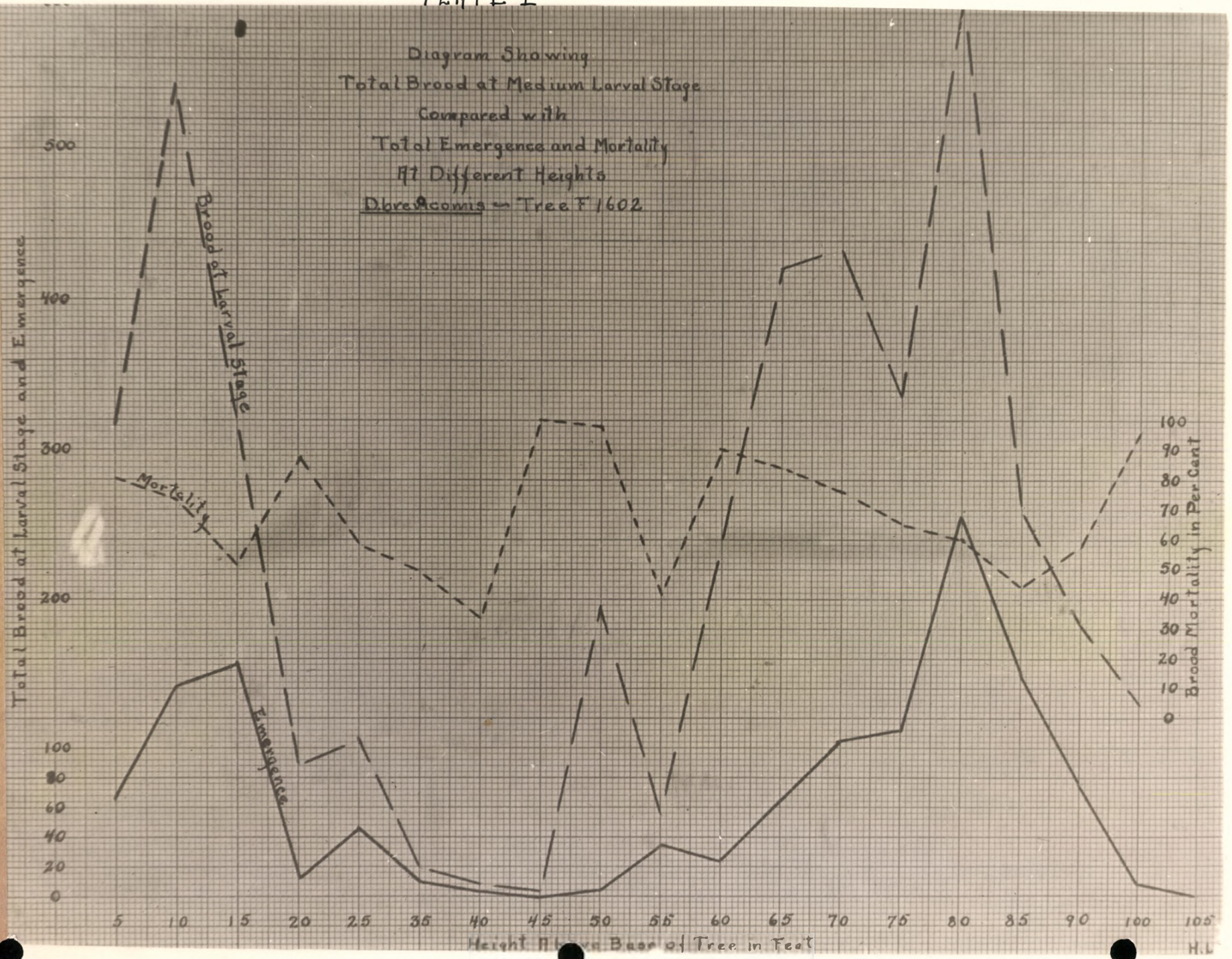


Diagram Showing
Total Brood at Medium Larval Stage
Compared with
Total Emergence and Mortality
At Different Heights
Dbrev Acowis ~ Tree F 1602
Total Brood at Larval Stage and Emergence
Brood Mortality in Per Cent
Brood at Larval Stage
Mortality
Emergence
500
400
300
200
100
90
80
70
60
50
40
30
20
10
0
5 10 15 20 25 35 40 45 50 55 60 65 70 75 80 85 90 100 105
Height Above Base of Tree in Feet
H.L

PLATE II

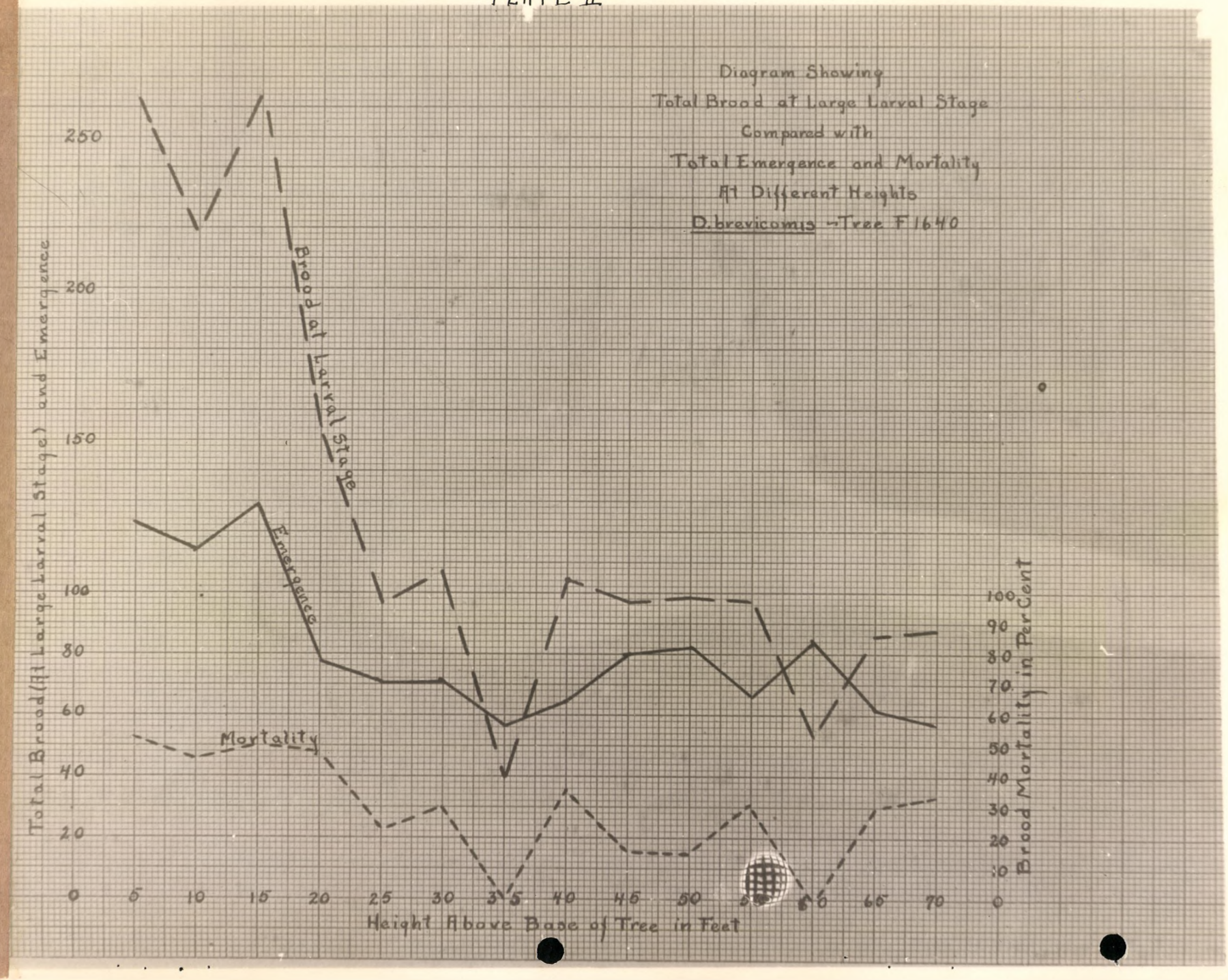


Diagram Showing
Total Brood at Large Larval Stage
Compared with
Total Emergence and Mortality
At Different Heights
D. brevicornis - Tree F 1640
Brood at Larval Stage
Emergence
Mortality
Total Brood (At Large Larval Stage) and Emergence
Brood Mortality in Per Cent
Height Above Base of Tree in Feet
250
200
150
100
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
100
90
80
70
60
50
40
30
20
10
0

PLATE III.

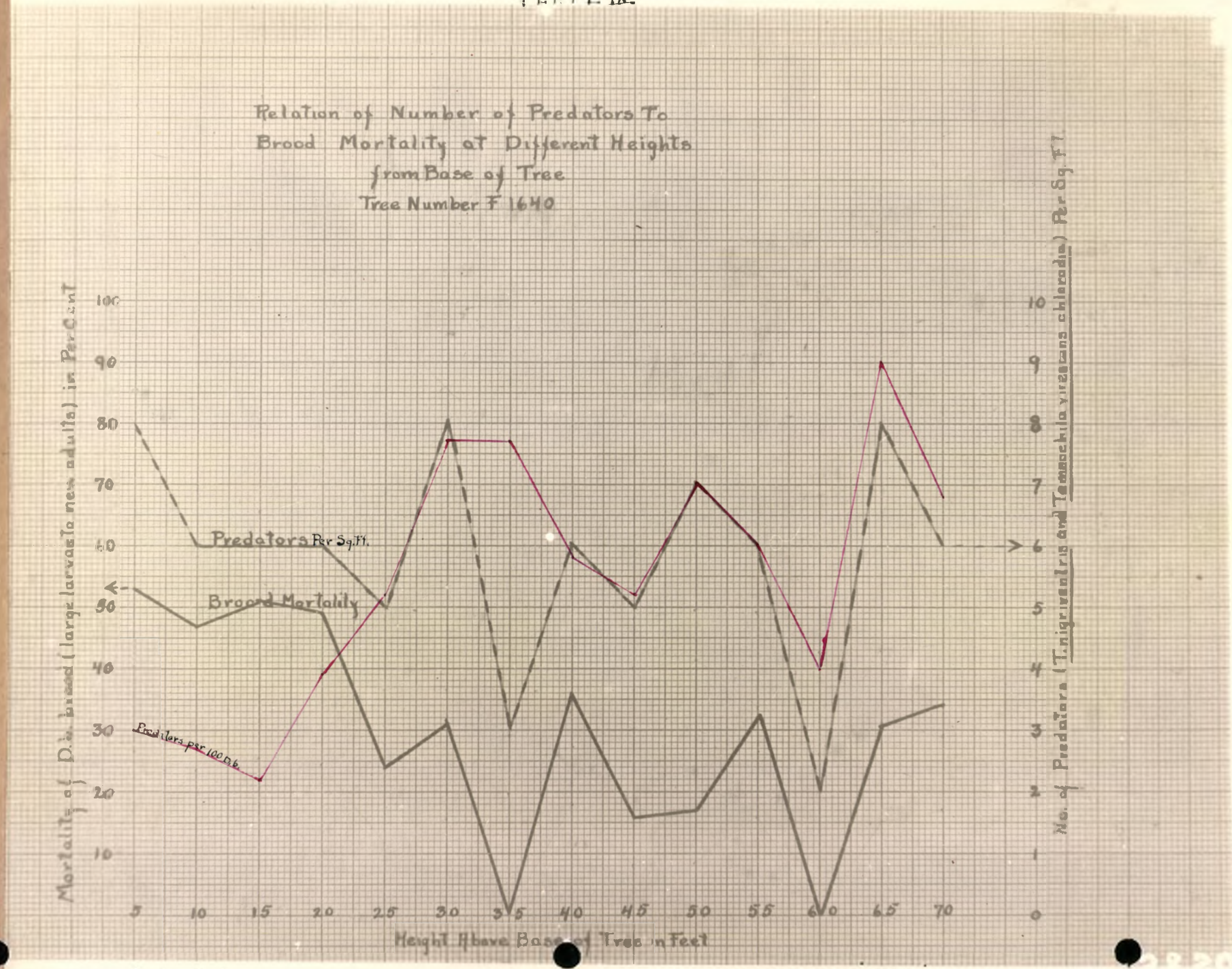

Relation of Number of Predators To
Brood Mortality at Different Heights
from Base of Tree
Tree Number F 1640
Mortality of D. a. brood (large larvae to new adults) in Per Cent
No. of Predators (T. nigriventris and Temnochila virescens chlorodia) Per Sq. Ft.
Predators Per Sq. Ft.
Brood Mortality
Predators per 100 D. a.
100
90
80
70
60
50
40
30
20
10
10
9
8
7
6
5
4
3
2
1
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Height Above Base of Tree in Feet

PLATE IV.

Graphs showing emergence periods for D. brevicomis and T. nigriventris from cage U.S. Hopk. No. 16809 and temperature curve for same period.

Daily average emergence was figured by five day periods since the cage was not collected from every day.

The temperature is the daily mean maximum for the same five day periods that the emergence graph is based upon.

The relation of D. b. emergence to temperature is apparent.

T. nigriventris is evidently not influenced by temperature to the same extent that D. brevicomis is.

The T. nigriventris scale is exaggerated as it would be impossible to draw an accurate curve on the same scale that the D.b. curve is drawn on.

The total emergence of D.b. based on a count of emergence holes in the bark was 14,642.

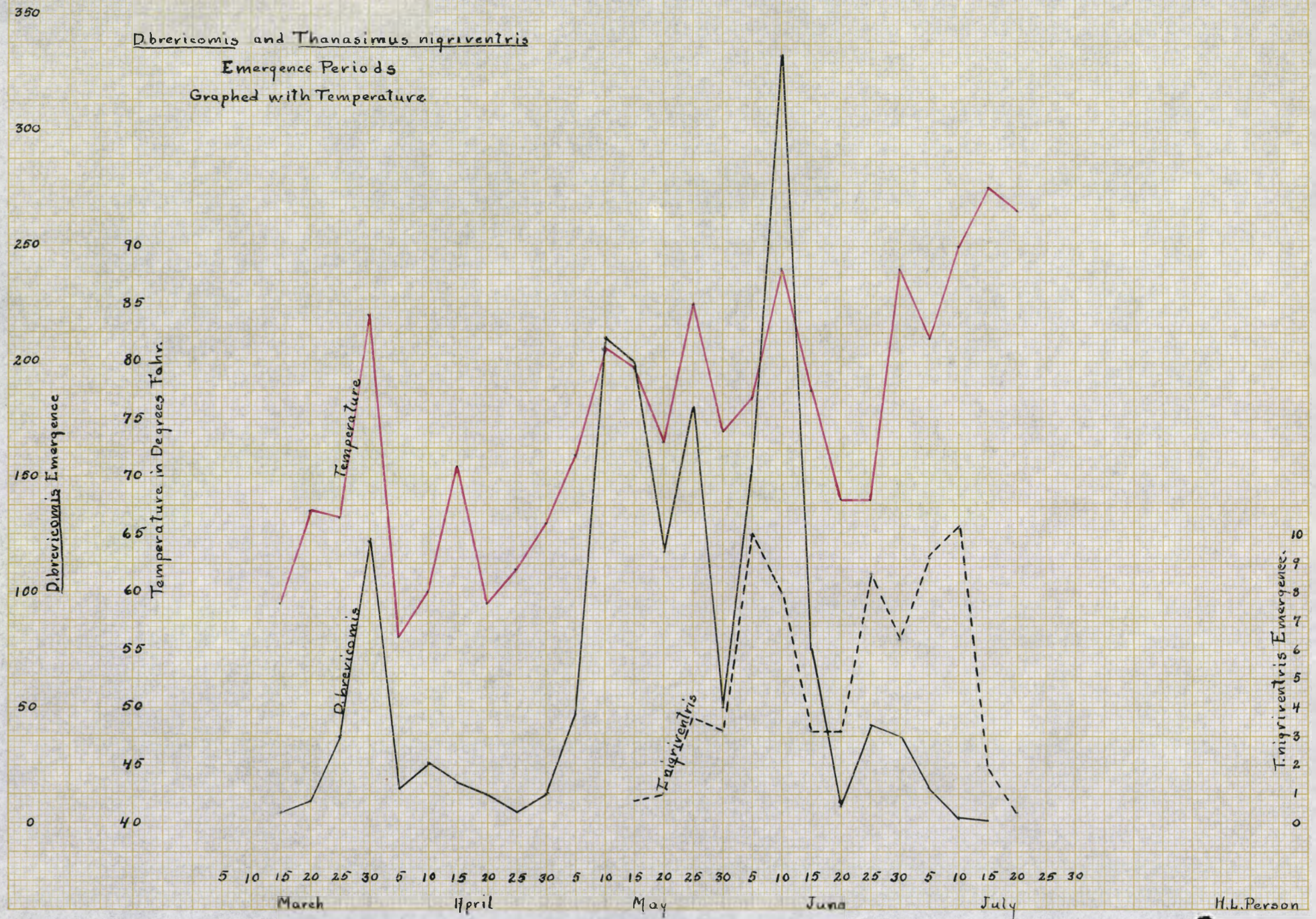
The total D.b. emergence collected was 8,702.

350 T. nigriventris were collected which is .04% of the D.b. emergence.

H. W. Webb, Sta. J, New York, N. Y.

PLATE IV

—Negative 2.



H.L.Person

PLATE V.

Graphs showing emergence periods for D. brevicornis and T. nigriventris from cage U.S. Hopk. No. 17017. Klamath Falls, Ore.

Daily average emergence figured by five day periods.

Compare with Plate LV.

The D.b. emergence period for cage 16809 covered about 125 days while the emergence period for cage 17017 covered only about 50 days.

The T. nigriventris emergence periods were proportionately long in cage 16809.

The small number of clerids is also noticeable in cage 17017.

PLATE V

Emergence Graph

D. brevicomis and T. nigriventris

from Gage U.S. Hopk No. 17017 110 sq. ft. of bark

Klamath Falls, Ore.

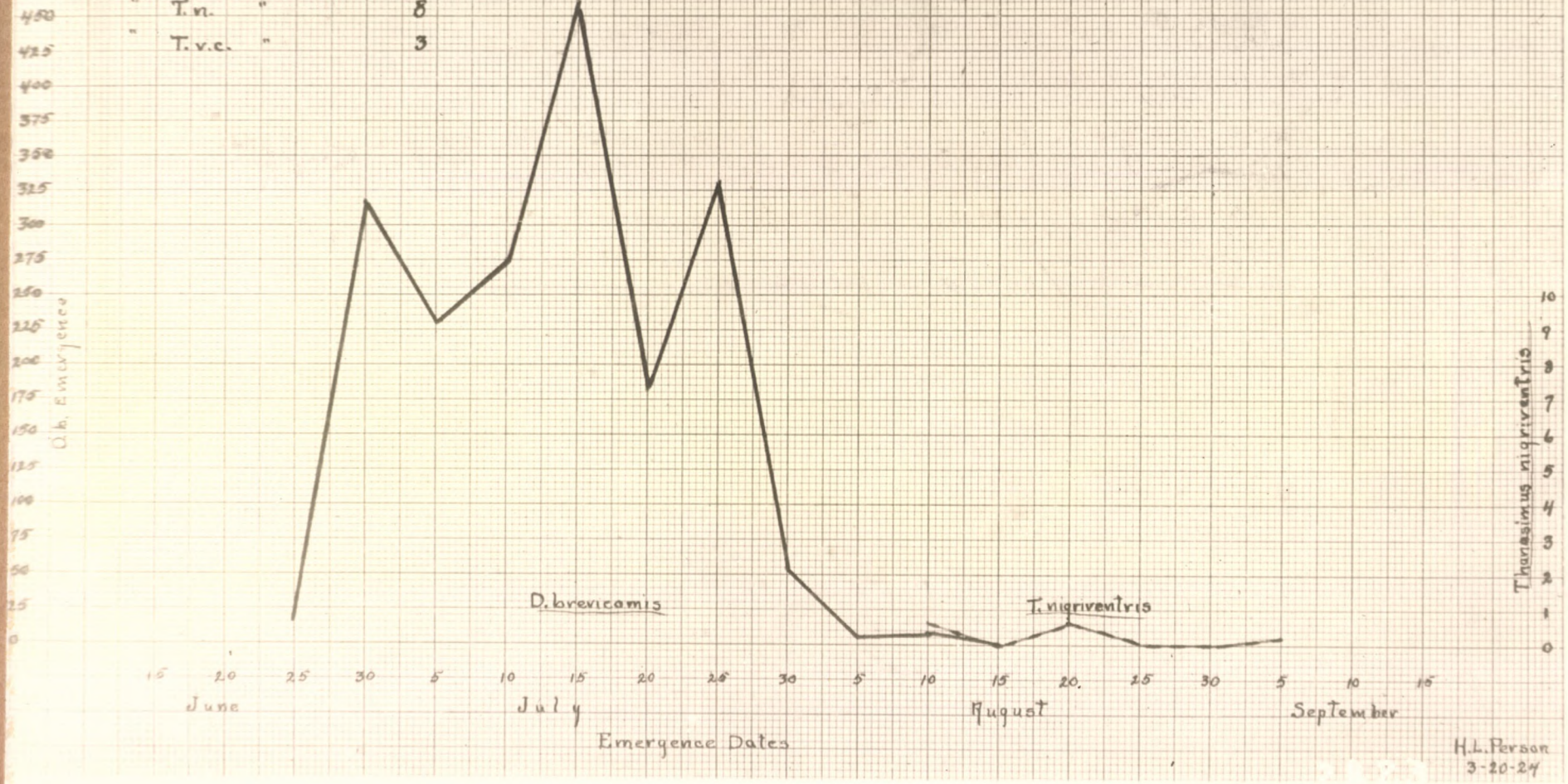
Daily Average Emergence Figured by Five Day Periods

T. nigriventris Scale Greatly Exaggerated

Total D. b. emergence 9,400

" T.n. " 8

" T.v.c. " 3



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3-20-24